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THE DISTRIBUTION OF EFFECTIVE RADIATION THROUGHOUT THE USSR

by L. N. D'yachenko

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ABSTRACT

Charts of yearly and monthly distribution of effective radiation throughout the Soviet Union based on measurement data are presented. An analysis and comparison with analogous charts, composed from calculation data, are performed.

A schematic chart of the yearly distribution of effective radiation throughout the Soviet Union, prepared from measurement data, is presented in reference 3. Its schematism is explained by the small number of actinometric stations (42) at which balance meter observations were performed, and the error of the probability method and other mistakes.

In recent years the number of actinometric stations has increased to 181 (1961). In connection with this, the possibility arises of compiling more precise charts of the yearly distribution of effective radiation and analogous monthly charts(a description and analysis of which are given in this present work).

Errors in measurement of the radiation balance found by thermoelectric balance meters indicate the precision of determination of longwave radiation as well as the errors introduced through the probability method. Investigation of these factors was conducted by S. I. Sivkov and K. D. Lebedeva (ref. 10), N. N. Andreyeva and M. A. Marshunova (refs. 1, 2) et al. S. I. Sivkov and K. D. Lebedeva showed that the sensitivity of the balance meter to longwave radiation is about 20 percent less than its sensitivity to shortwave. Apart from the preceding works, we introduced the corresponding correction to the transfer factor.

The use of the measurement data was complicated by the diversity of types of observations of the radiation balance at various stations. A chart of the relation of monthly totals of effective radiation and absorbed radiation was used to lengthen the periods of observations. With its help, monthly

totals of effective radiation were determined in those cases when the radiation balance was not measured (refs. 1, 7).

Thus, in the construction of yearly and monthly charts of distribution of effective radiation, data were used for the greatest period possible through 1961 inclusive.

Isolines of the effective radiation were entered onto all charts mentioned in the work, which were constructed both by measurement data (1) and by calculations (2) (refs. 4, 5, 6, and 8). In the construction of the latter, we used the data of N. A. Yefimova, on the basis of which she evolved charts for the distribution of effective radiation throughout the world (ref. 9).

In construction and analysis of the charts, average multiyearly quantities of effective radiation were examined, the distribution of air temperature throughout the Soviet Union, the amount of precipitation, the number of days with precipitation, and the total solar radiation were considered. Besides this, charts of average cloud cover, introduced by T. G. Berlyand (ref. 4), were used.

Figure 1 shows a chart of the distribution of yearly totals of effective radiation. Isolines in it are marked at 10 kcal/cm^2 year. A sufficiently close coincidence of measurements and calculations of data can be noted.

Due to an insufficiency of data, we did not consider mountainous regions marked on the charts as over 1000 m above sea level.

Analysis of this chart (ref. 1) shows that the entire Soviet Union is characterized by a monotonic decrease of effective radiation with an increase in altitude. The least yearly totals take place in the north and amount to a quantity of the order of 20 kcal/cm^2 year. The field of effective radiation in the north of the Soviet Union was diffuse, with small gradients.

The maximum quantities of yearly totals of E_{ef} are observed in Central Asia (in the sands of Karakum and in the region of the Karabil heights) and reach values of the order of 70 kcal/cm^2 year.

In the north and central regions of the European territory of the USSR, isolines have a latitudinal path. In elevated areas (Middle Russia, the Volga region) and in the mountains (the Urals) isolines run to the south. This is partly explained by the decrease in temperature with altitude and an increase in cloud cover. To the south of the ET, the quantity of E_{ef} increases by degrees and in the regions of the Crimean peninsula and the Caucasus amounts to 50 kcal/cm^2 year. In the region of the Caucasus, E_{ef} decreases are observed with increases in absolute altitude above sea level. This results in a

lowering in temperature with altitude and an increase in cloudiness and precipitation in the mountains. In the Kurinsk lowlands we observed a growth of E_{ef} in comparison with the adjoining mountainous area. This is explained by the presence of high temperatures and light cloudiness throughout the year and an insignificant amount of precipitation ($\approx$ 200 mm). In the Kolkhidskaya plain, the increase in E_{ef} is found to be significantly weaker, which can be explained by substantial cloud cover.

In the Asiatic territory of the Soviet Union, isolines of yearly E_{ef} totals have in general a latitudinal direction. This is not true only near mountainous lines and in the monsoon regions. Maximum quantities of E_{ef} in the Asiatic territory of the Soviet Union, except Central Asia, are observed in the Amur basin and in the region of lake Hasan, and have an amount exceeding 40 kcal/cm^2 year.

On the monthly charts of E_{ef} distribution presented in figures 2 - 13, isolines are derived at 1 kcal/cm^2 month. Their analysis shows that in the winter period (December, January, February) the quantity of monthly totals of effective radiation changes from 1 kcal/cm^2 month in the north to 4 kcal/cm^2 month in the south. In Central Asia, in the region of the Karakum sands it reaches values exceeding 3 kcal/cm^2 month in December and January and 4 kcal/cm^2 month in February. Such monthly totals exist also in the Far East.

In central and northern parts of the USSR the field of effective radiation is strongly increased. The monthly totals of $\Sigma_m E_{ef}$ fluctuate around 1 kcal/cm^2 month.

In the Caucasus, the Kurinsk valley is well described, where the $\Sigma_m E_{ef}$ surpassed values of 3 kcal/cm^2 month.

In spring, with an influx of heat over the entire Soviet Union, we observe the growth of effective radiation. It varies from values less than 2 kcal/cm^2 month in the north to greater than 5 kcal/cm^2 month in the south of Central Asia. In April and May the $\Sigma_m E_{ef}$ varies from 2 kcal/cm^2 month in the north to 6-7 kcal/cm^2 month in the south. The maximum in the region of the Siberian plateau and the Putarano mountains is indicated by low temperatures and heavy cloud cover.

In the ET and the Baltic area, isolines run to the south, which also can be explained by the increase in cloud cover.

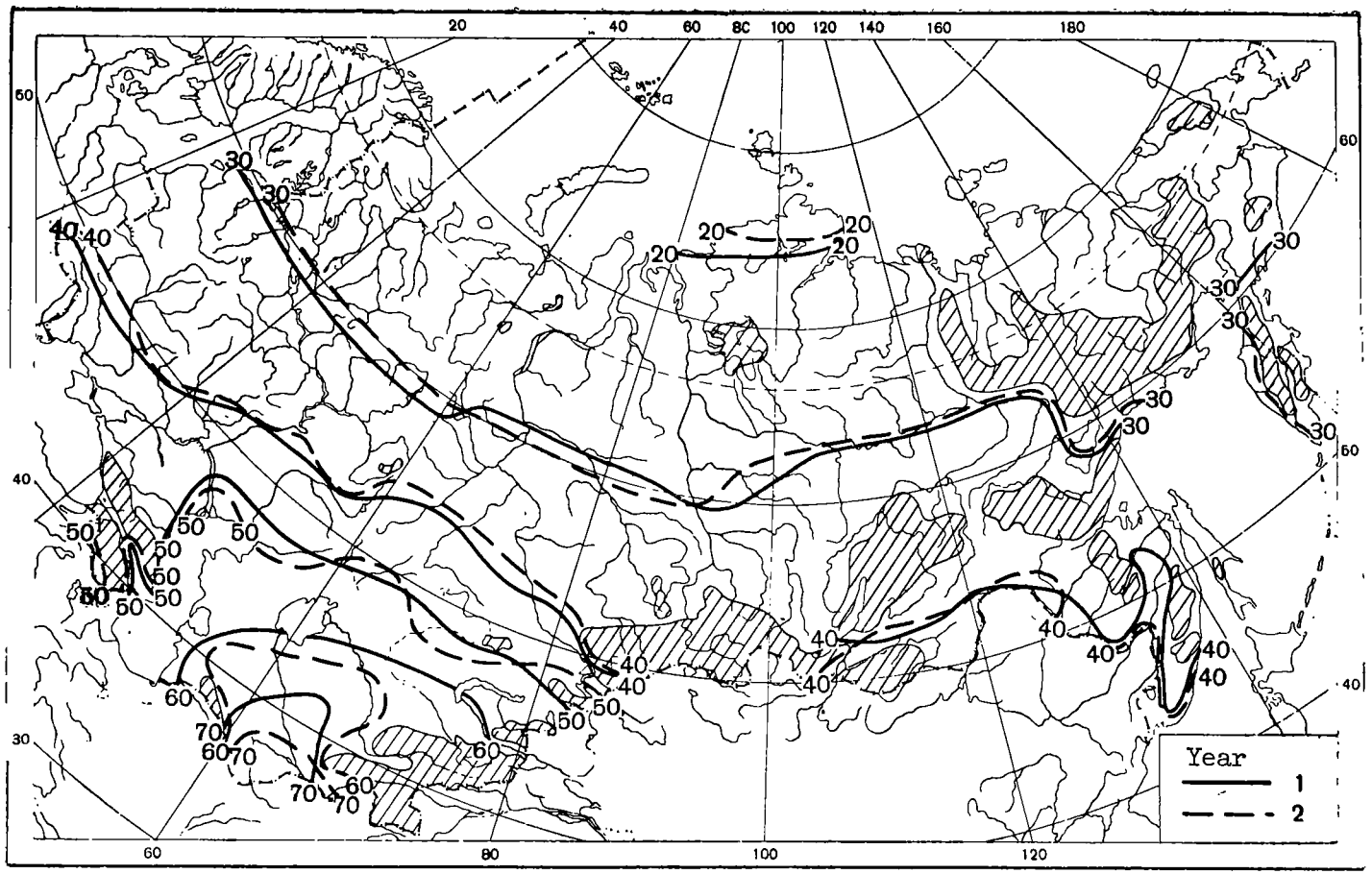
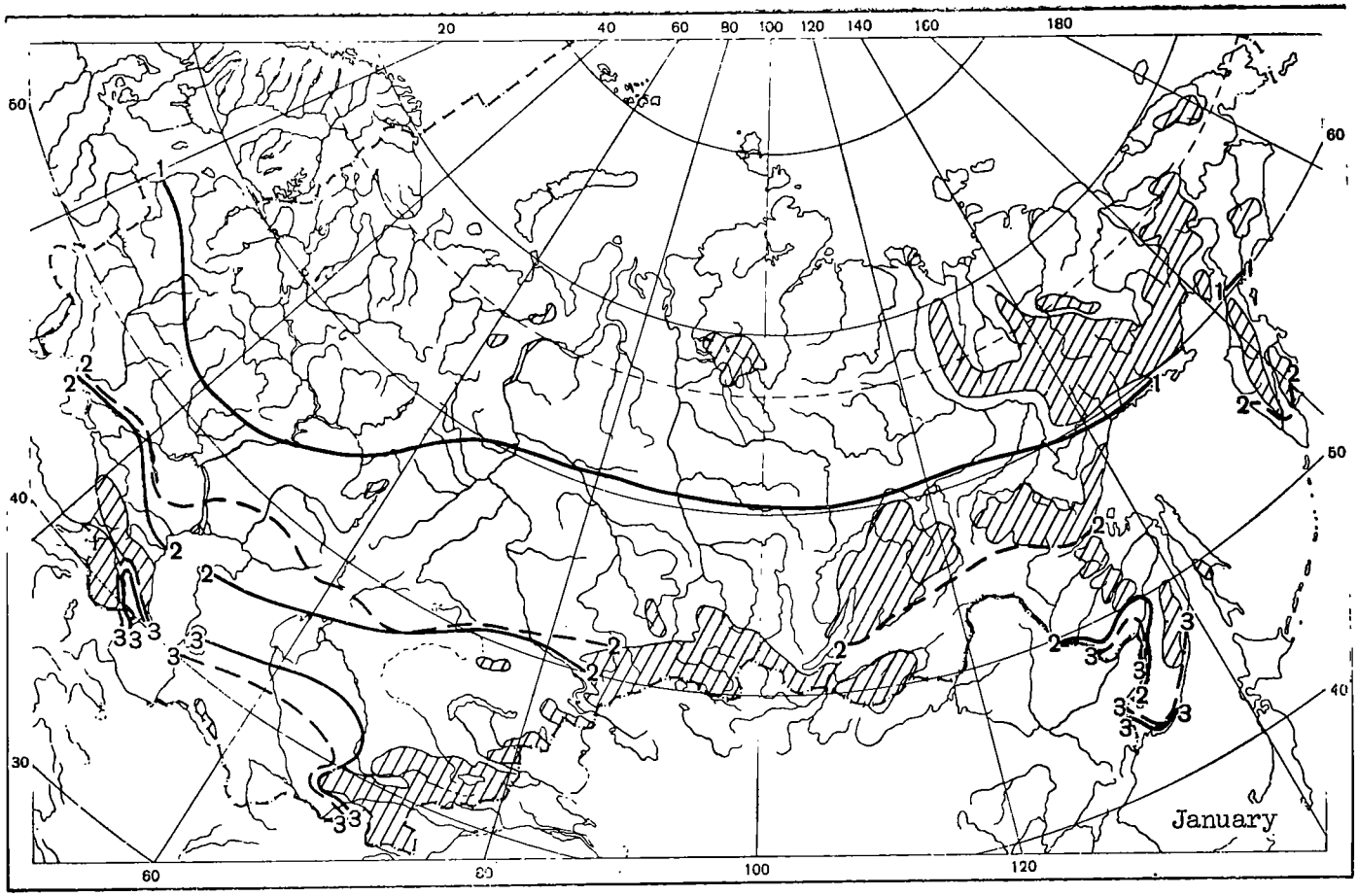


Figure 1.



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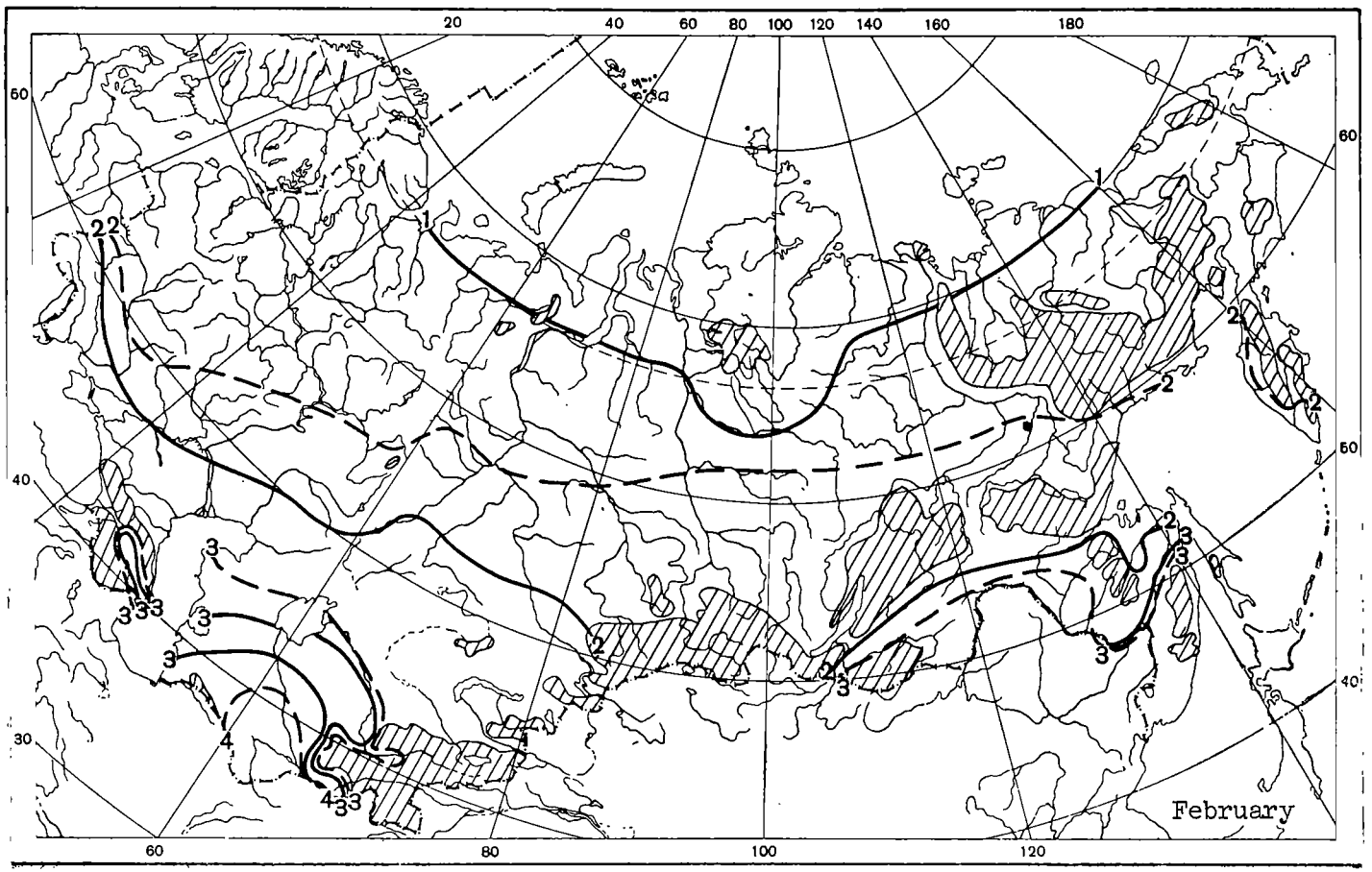

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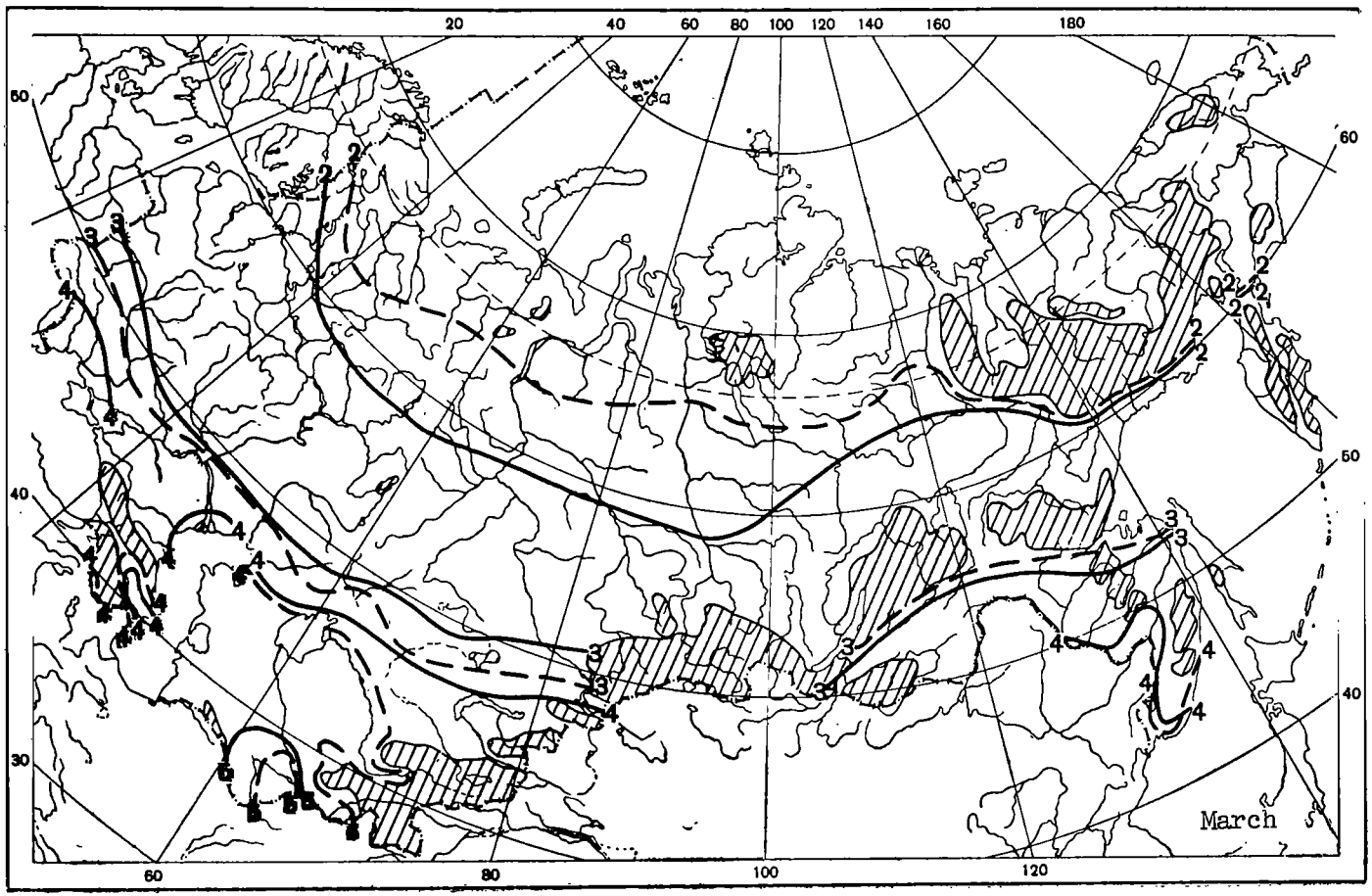

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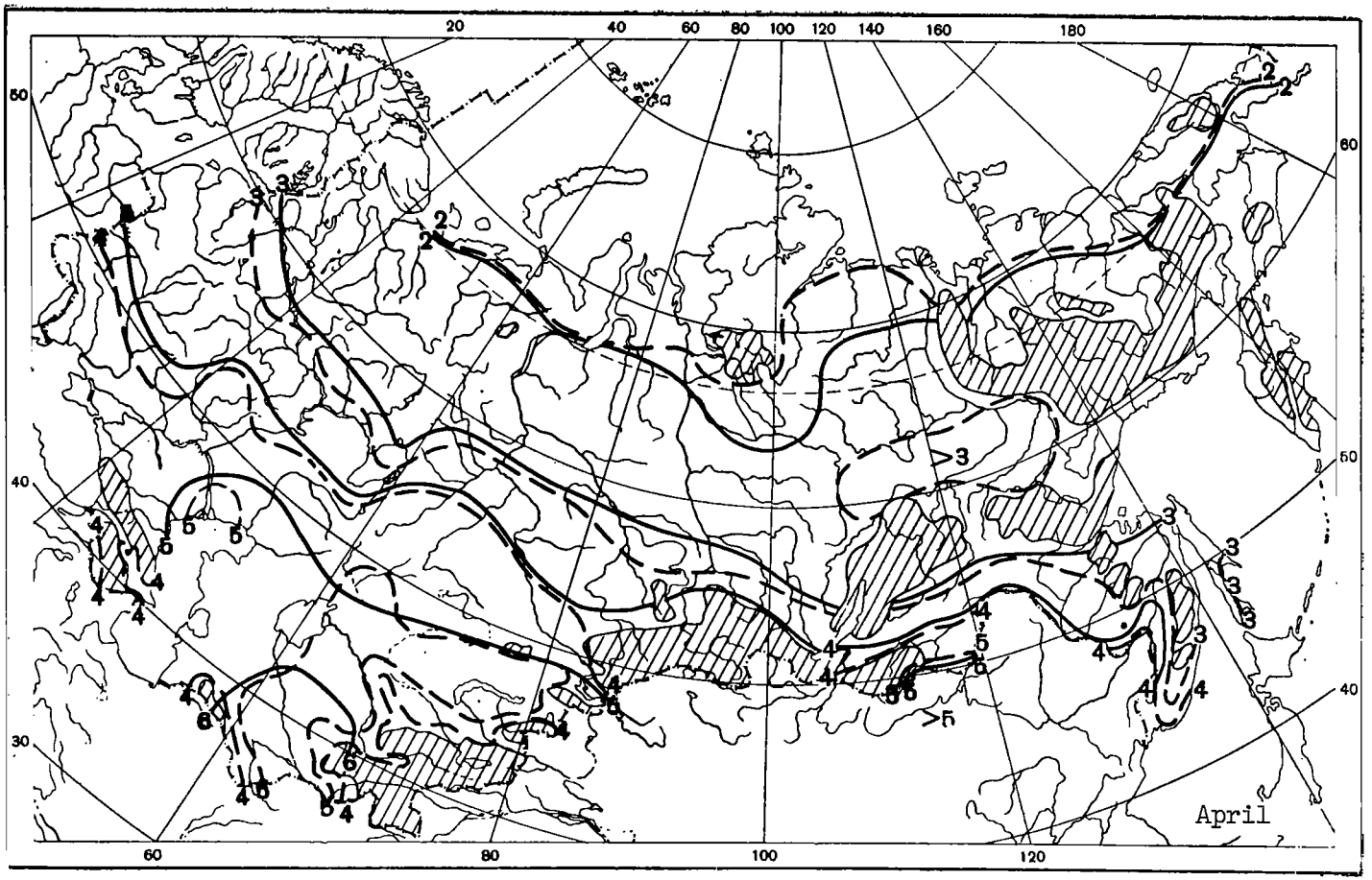

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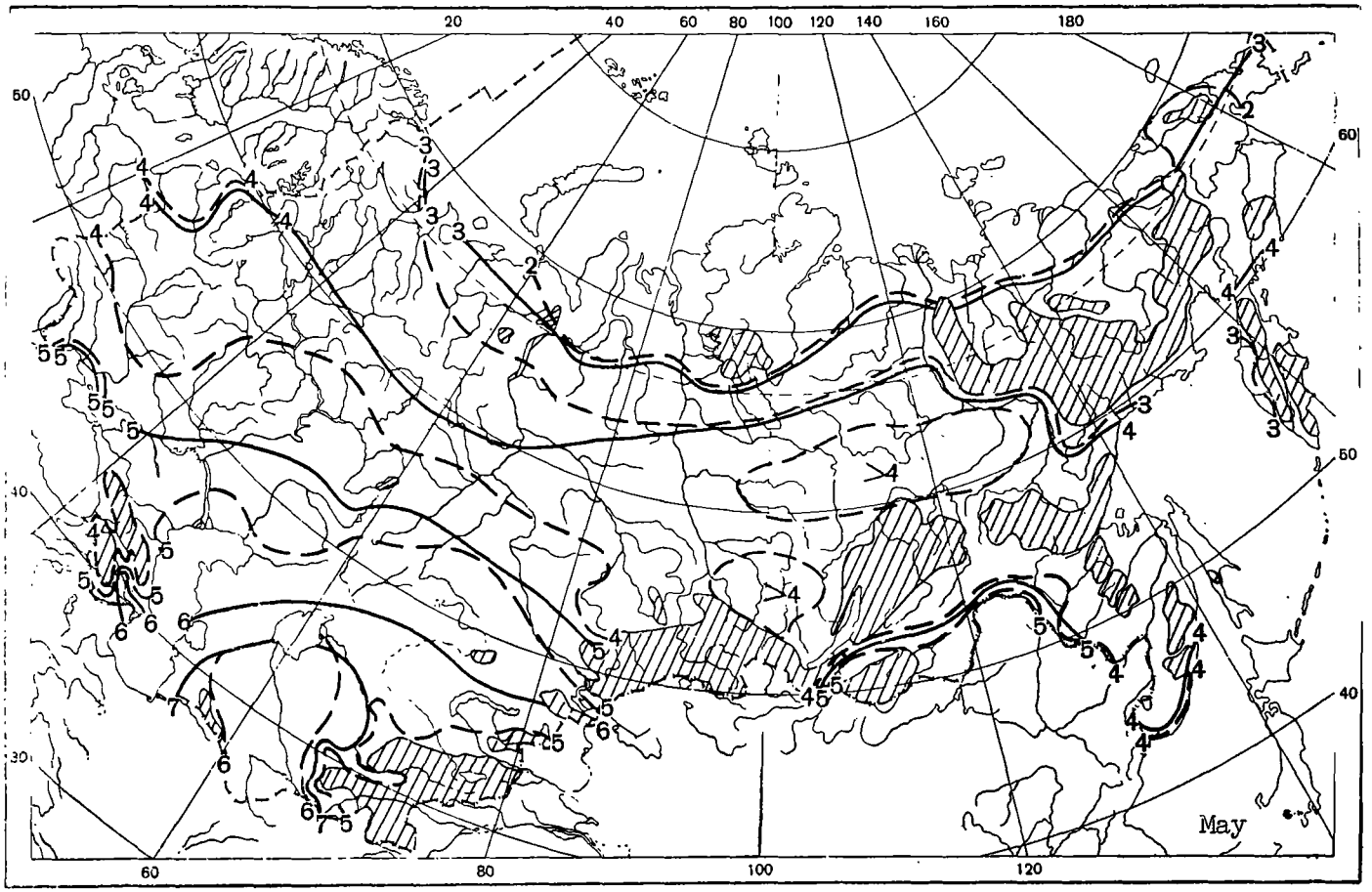

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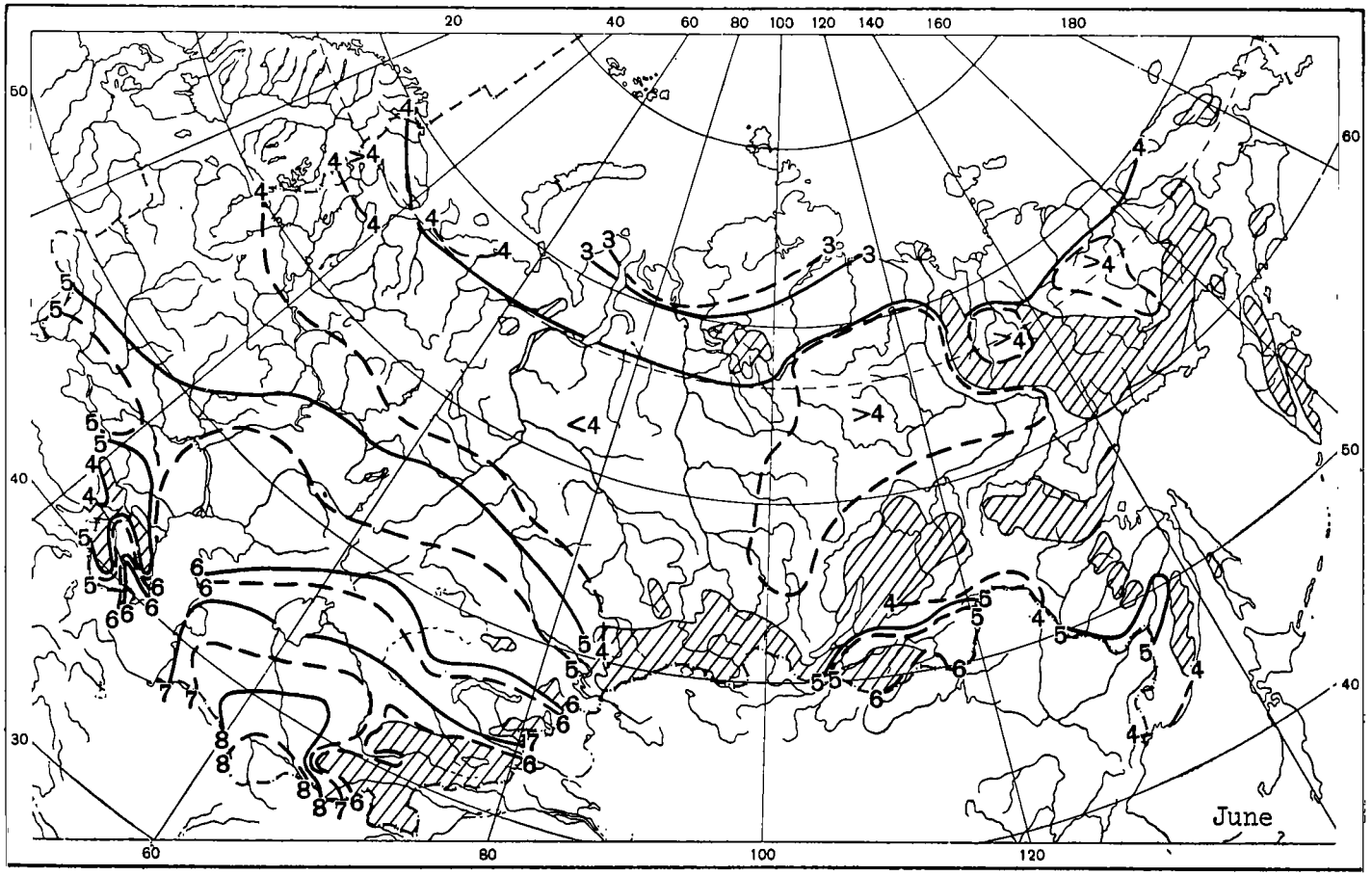

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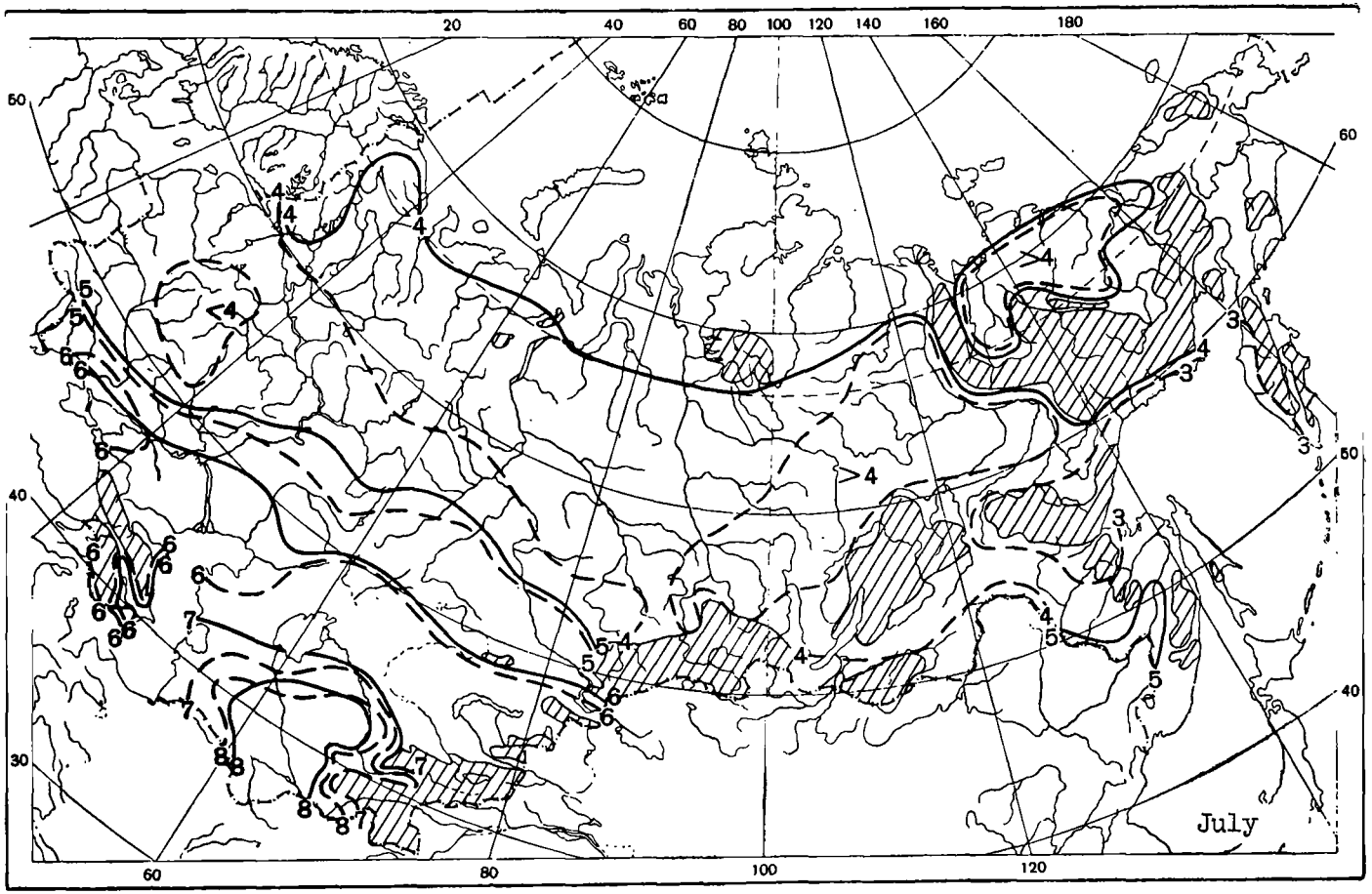

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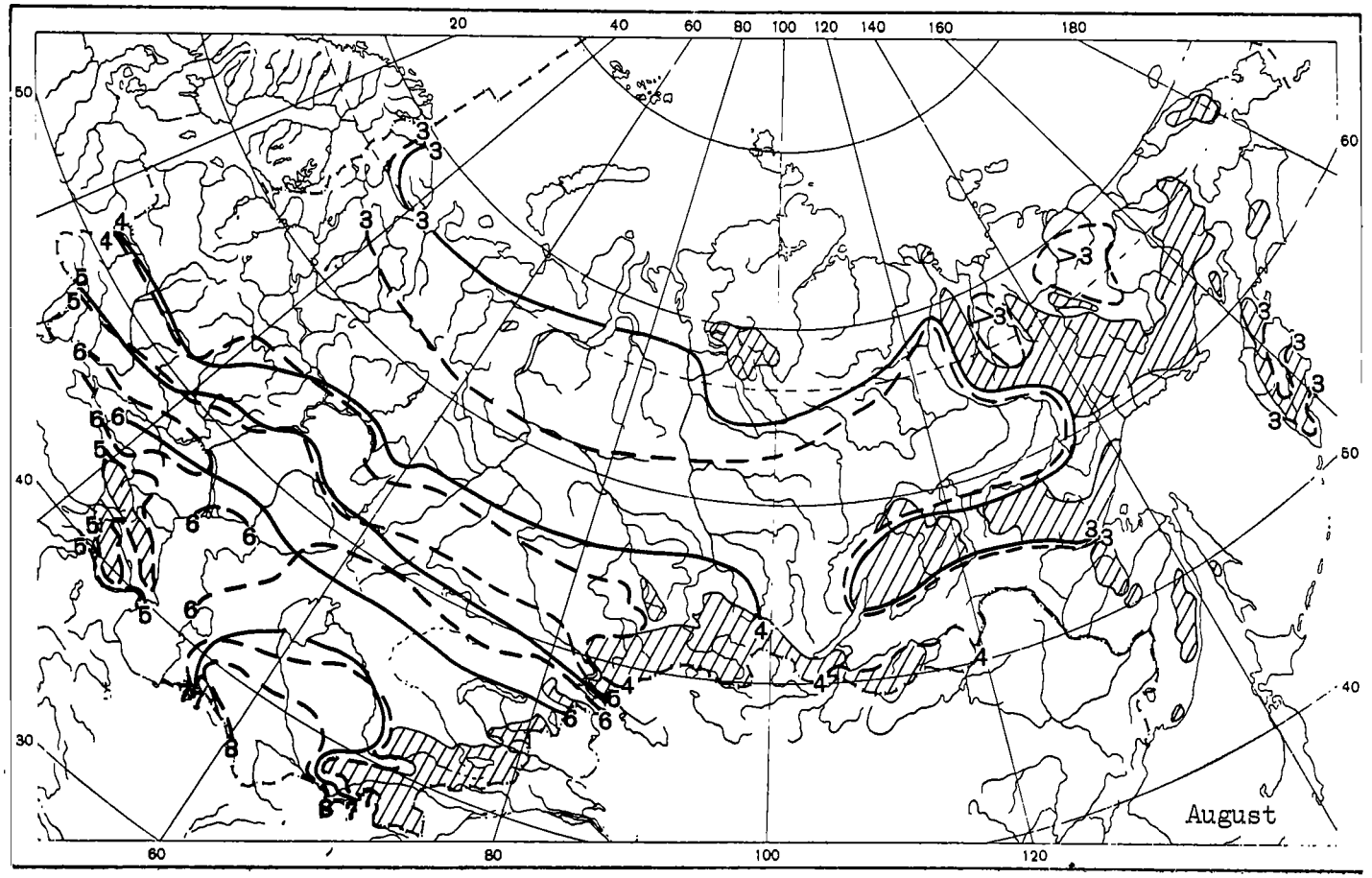
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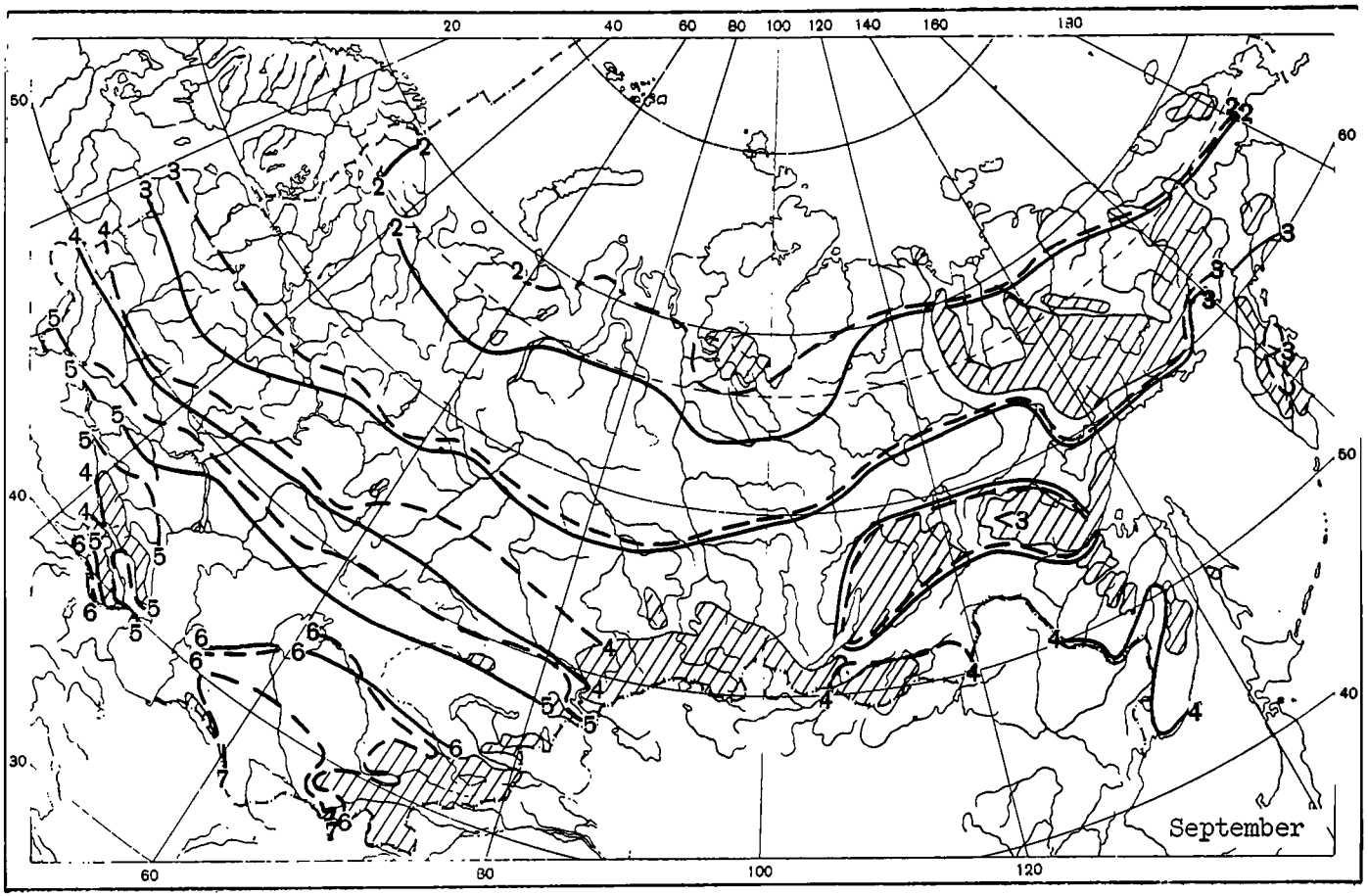
Figure 9.



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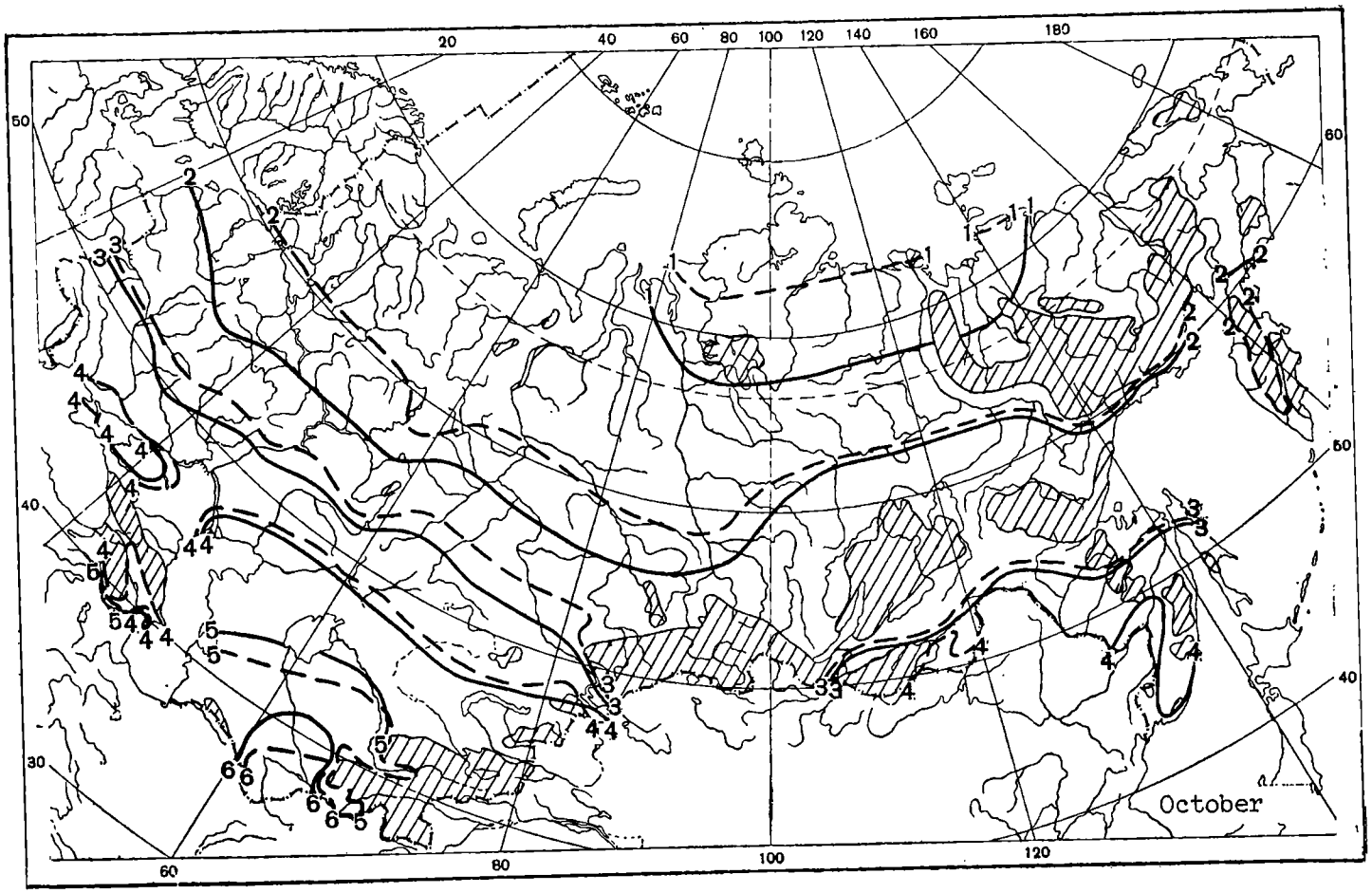

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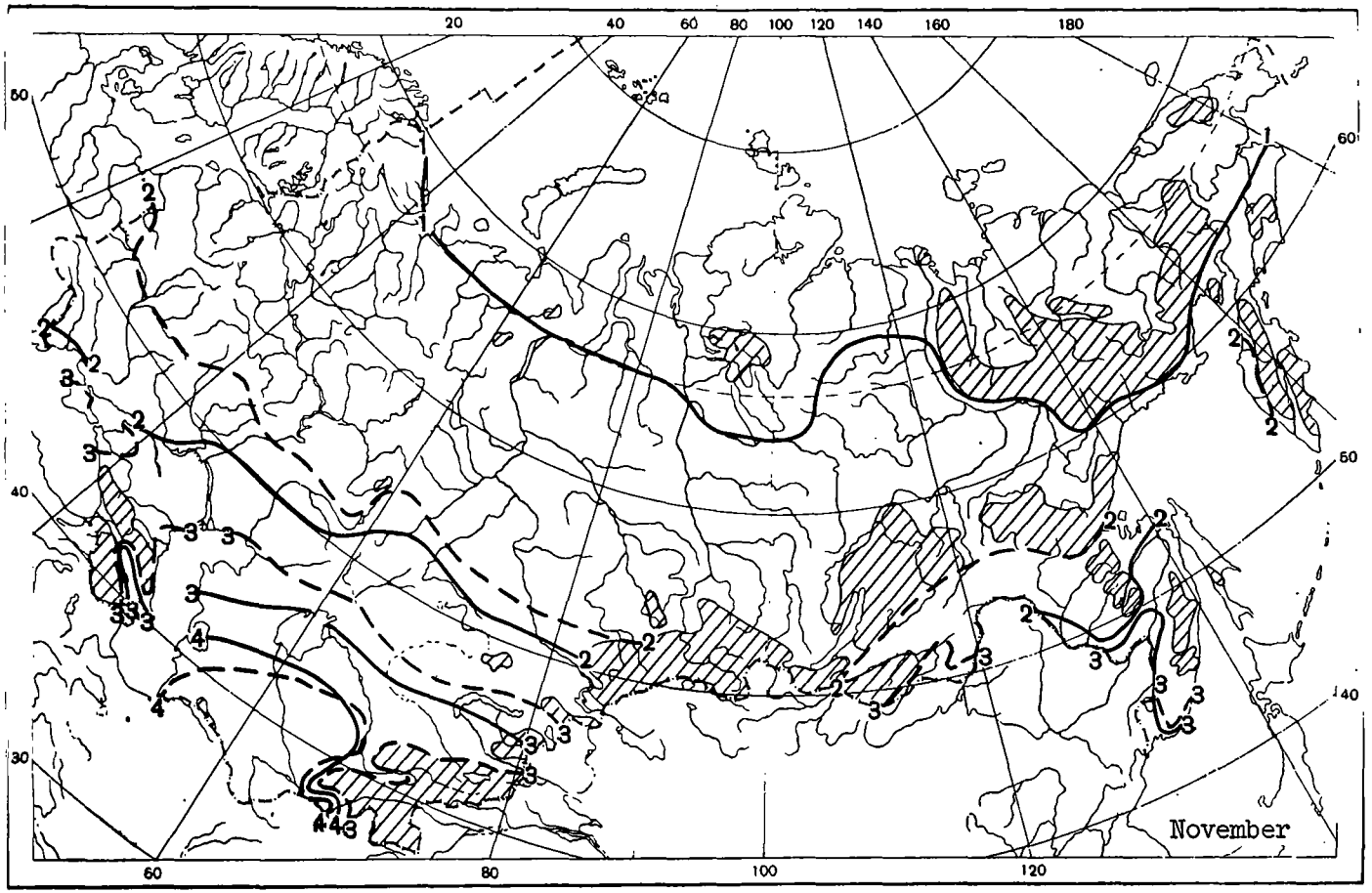

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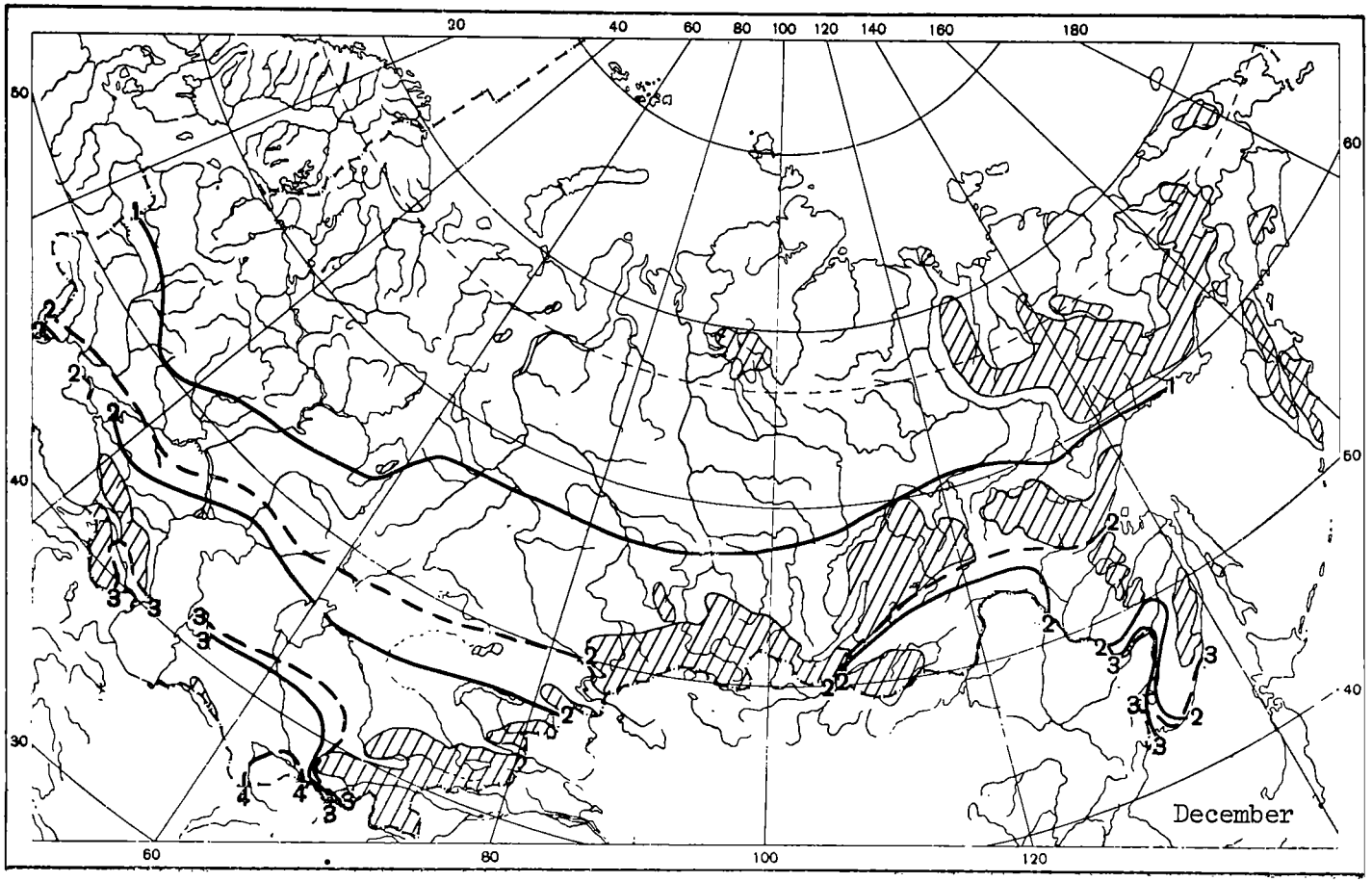

Figure 13.

During the warm period (June, July, August) the monthly totals of effective radiation reach the yearly maximum. To the south of Central Asia they approach values greater than 8 kcal/cm^2 month. In this region the highest temperatures in the Soviet Union and insignificant cloudiness are observed.

In September, October, and November the amount of effective radiation gradually decreases to 1 kcal/cm^2 month in the north and to 4 kcal/cm^2 month in the south.

In conclusion it should be noted that comparison of measured amounts of effective radiation and corresponding calculated values gives the possibility of arriving at a sufficiently close correspondence.

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